PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements relating to the Heating of Fluids, such as Fuel Oils

We, URQUHART'S (1926) LIMITED, a British Company, of 5, Wadsworth Road, Perivale, Greenford, Middlesex, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns the rapid and controlled heating of fluids, more particularly the heating of viscous liquids, such as fuel oils, by means of electric power.

In the heating of liquids it is common practice to immerse a heating element, usually of tubular form, into the liquid contained in a tank or container; such devices being known as immersion heaters.

Where viscous liquids are to be heated the natural convection currents in the liquid are slow, and, therefore, the heat distribution might be slow and uneven. Thus there is the danger of overheating the liquid in the vicinity of the heating element itself, unless some mechanical stirring device is also employed. Furthermore, upon shutting off the heat, there is a relatively large heat content in the heating element which may cause physical or chemical change in the liquid, when the liquid has ceased to flow through and over the heater.

In the oil-burning industry it is common practice to use electrical immersion heaters for heating oil, as described above. Such heated oil containers are usually large and have rather high thermal inertia; that is to say, heating up and cooling down rates.

The present invention overcomes the above disadvantages and gives, in particular, great compactness and low thermal inertia. The invention achieves a large heating surface, and relatively high velocity of the liquid over such heating surface.

Accordingly the present invention provides a fluid heating device comprising at least one metal-clad electrical heating element of square, triangular or other rectilinear cross-section which presents a flat surface on at least two sides and is disposed in direct contact with one or more tubular fluid ducts each consisting of metal tube of rectilinear cross-section whereby the heating element or each element is flanked on the said at least two sides by sections of said fluid duct or ducts through which the fluid to be heated flows.

Conveniently a plurality of concentric or coaxial heating elements and associated fluid ducts are used and direct contact between a tubular electrical element and its associated fluid duct is achieved by sandwiching a plurality of contacting concentric or co-axial square or triangular section heating elements between corresponding pluralities of fluid ducts arranged in contact with upper and lower, or inner and outer surfaces of said heating elements, that is, the apparatus comprises a multi-layer pancake or hollow cylinder or cylindrical coil. Alternatively a single flat ring-like heating element may be sandwiched between a plurality of concentric fluid ducts or between two spirally wound fluid ducts. For instance, two fluid ducts, each consisting of a flat spirally coiled length of metal tubing, may be arranged to flank the opposite side faces of a single flat ring-like heating element; those ends of the two lengths of tubing into which the fluid to be heated enters are conveniently brought together to form a common inlet, and the opposite ends of the tubing may be similarly connected to a common outlet. It will be understood that

more than one flat ring-like heating element and more than two fluid ducts may be combined in a single heating device.

The square etc. section tubular electrical heating elements are preferably ceramic-filled metal tubes such as are commonly employed for hot-plates; normally these are arranged either in a helical coil or a spiral pancake, and such electrical heating elements are usually formed by compressing circular tubes to make them of the required cross-section, to suit the particular application of the heater; electric resistance wires are embedded in this compressed ceramic powder.

In making a fluid heating device according to this invention it is preferred to distort the circular heating element tube into a rectangular or approximately square section and to coil the element either spirally or helically so as to present flat surfaces on either side of the coiled element for assembly into a pancake or cylindrical heating device by pressing into direct contact with the opposite flat surfaces of the electrical heating element metal fluid duct tubing distorted in a similar manner into approximately square section and similarly coiled.

A further method is to distort the circular heating element to an equilateral triangular section. and also the fluid duct tubing into a similar section, and arrange them in triangular groups of one heating element and three fluid ducts, the three sides of the heating element being covered by one side of each of the three triangular fluid ducts, such groups then being wound into coils to lie close together forming, in effect, a double pancake layer. Alternatively two layers of triangular section fluid ducts may be assembled with an interposed layer comprising corresponding triangular section heating elements or a series of collateral diamond shaped heating elements.

To increase the effectiveness of the surface of the heating element, it may be coiled together with a solid bar of the same section, so that convolutions of the heating element proper alternate with convolutions of the solid bar.

Heating units can be standardised and arranged in series, or parallel, in accordance with the temperature required and the flow rate of the liquid. The heating units are arranged with surrounding thermal insulation in cylindrical, rectangular or other shaped boxes.

In order that the invention may be more readily understood, some embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, wherein:—

Figures 1 and 2 are part-sectional perspective views of a pancake heater and a cylindrical heater respectively;

Figure 3 is a side view of the flat ring-like heating element of a further embodiment;

Figure 4 is a vertical cross-section on line A—A of Figure 3, showing also the casing of the heater; and

Figure 5 is a fragmentary sectional view showing the outlet ends of the two fluid ducts of Figures 3 and 4 brought together at a common outlet.

In the embodiments illustrated in Figures 1 and 2, a plurality of separate heating elements 1, preferably square section metal clad ceramic rings having resistance wires 2 embedded therein, or a single square section metal clad ceramic heating element 1 formed into a flat spirally or helically wound coil with convolutions in lacteral contact, are or is sandwiched between square section fluid ducts 3 similarly wound; the fluid ducts align with corresponding heating elements 1. The rows of heating elements 1 and fluid ducts 3 are thus arranged in collateral and row-to-row direct contact either concentrically to form a pancake heater as illustrated in Figure 1 or co-axially to form a hollow cylindrical heater as illustrated in Figure 2. The top and bottom ducts 3 (Figure 1) or inner and outer ducts 3 (Figure 2) may form two separate fluidways or, as indicated, fluid may enter the heater at point 4, be suitably transferred as indicated by line 5 and may leave the heater at point 6. The pancake heater is not necessarily circular—it could be of oblong or any other suitable shape.

In the embodiment illustrated in Figures 3 to 5, a single flat rink-like resistance heating element 10 in the form of a metal-clad ceramic filled heating element is flanked by two identical fluid duct units 11, 11A. Each unit, such as unit 11, comprises a flat spirally coiled length of metal tube 12 with a banjo-type inlet adaptor 13 on one end, preferably as shown on the inner end of the tube 12, and a similar outlet adaptor 14 on the other end. The tube 12 is of square cross-section so that the convolutions of the coiled tube are, in the main, in full width contact one with another and in intimate contact with one side of the flat heating element 10. The equivalent parts of the unit 11A are marked 12A, 13A and 14A respectively.

Some parts of the convolutions of at least the tube 12 are straight (that is, from chords of arcs), as shown in Figure 3, so as to provide a chordal gap for the reception of a terminal block 15 projecting from at least one side of heating element 10; conveniently the tube 12A is similarly fashioned so that tubes 12 and 12A are interchangeable.

Any suitable fitment (not shown) may be used to connect the two inlet adaptors 13, 13A together; the two outlet adaptors 14, 14A are shown (Fig. 5) as mounted side-by-side on a ported outlet connector 16, which

may be associated with a thermostatic control unit 17.

The two tubes 12, 12A with the interposed heating element 10 are encased in a sheathing 18 of heat-insulating material, and this sheathing 18 is clamped between side plates 19 held together by transverse screw fasteners 20.

WHAT WE CLAIM IS:—

1. A fluid heating device comprising at least one metal-clad electrical heating element of square, triangular or other rectilinear cross-section which presents a flat surface on at least two sides and is disposed in direct contact with one or more tubular fluid ducts each consisting of metal tube of rectilinear cross-section whereby the heating element or each element is flanked on the said at least two sides by sections of said fluid duct or ducts through which the fluid to be heated flows.

2. A fluid heating device according to claim 1, comprising a plurality of concentric heating elements sandwiched between corresponding pluralities of said fluid ducts which are in contact with upper and lower surfaces respectively of the heating elements to form a multilayer pancake.

3. A fluid heating device according to claim 1, comprising a plurality of co-axial heating elements sandwiched between corresponding pluralities of said fluid ducts which are in contact with inner and outer surfaces respectively of the heating elements to form a hollow cylindrical coil.

4. A fluid heating device according to claim 2 or claim 3, wherein the ducts are interconnected such that the fluid to be heated flows first through the fluid ducts in the upper or outer plurality and thence through the ducts in the lower or inner plurality.

5. A fluid heating device according to claim 2 or claim 3, wherein the fluid ducts in the upper or outer plurality and the ducts in the lower or inner plurality are arranged to provide separate fluidways for flow of the fluid to be heated.

6. A fluid heating device according to any one of the preceding claims, wherein the heating element or elements and the fluid ducts are of similar approximately square section.

7. A fluid heating device according to claim 1, comprising a single flat ring-like heating element sandwiched between a plurality of concentric fluid ducts.

8. A fluid heating device according to claim 1, comprising a single flat ring-like heating element sandwiched between two spirally wound fluid ducts.

9. A fluid heating device according to claim 8, wherein each fluid duct consists of a flat spirally coiled metal tube flanking a side face of the heating element, those ends of the tubes into which the fluid to be heated enters being connected to a common inlet, and a common outlet connected to the opposite ends of the tubes.

10. A fluid heating device according to claim 9, comprising an adaptor fitted to each end of each tube, the adaptors at the inlet end and at the outlet end being mounted on a respective ported connector.

11. A fluid heating device according to claim 10, wherein a thermostatic control unit is associated with the outlet connector.

12. A fluid heating device according to claim 9, claim 10 or claim 11, wherein some part of the convolutions of either or both spirally coiled metal tubes is formed straight to provide a chordal gap for reception of an electrical terminal block for the device.

13. A fluid heating device according to any one of claims 2 to 6, in which the plurality of heating elements is replaced by a single spirally or helically coiled element with convolutions in lateral contact.

14. A fluid heating device according to claim 13, wherein the heating element is coiled together with a solid bar of the same section such that convolutions of the heating element alternate with convolutions of the solid bar.

15. A fluid heating device according to claim 1, wherein the heating elements have a triangular section, the fluid ducts have a similar section, and are arranged in triangular groups of one heating element and three fluid ducts, the three sides of the heating element are covered by one side of each of the three fluid ducts, such groups being disposed in coils to form a double pancake layer.

16. A fluid heating device according to claim 1, wherein two layers of triangular section fluid ducts are assembled with an interposed layer of corresponding triangular section heating elements or a series of collateral diamond shaped heating elements.

17. A fluid heating device according to any one of the preceding claims, wherein the or each electrical heating element consists of a metal tube of the required section filled with a compressed ceramic powder in which is embedded an electric resistance heating wire or wires.

18. A fluid heating device according to any one of the preceding claims further comprising a sheathing of heat-insulating material and an outer casing.

19. A fluid heating device constructed substantially as hereinbefore described with reference to Figure 1, Figure 2 or Figures 3 to 5 of the accompanying drawings.

20. A heater for viscous fuel oils comprising the fluid heating device as claimed in any one of the preceding claims.

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Agents for the Applicants.

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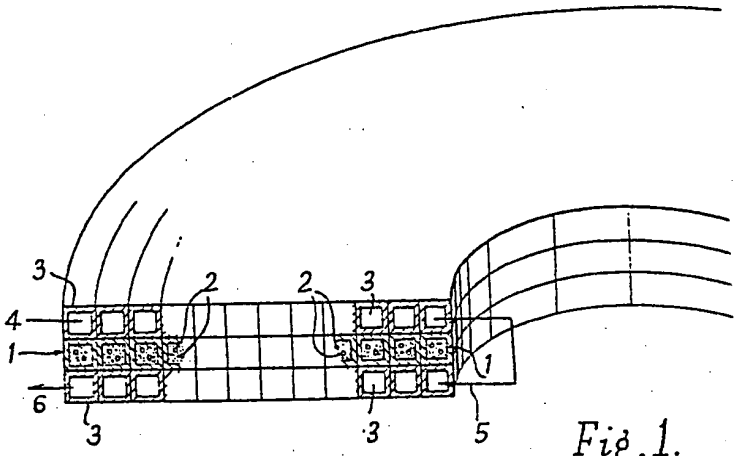

Fig.1.

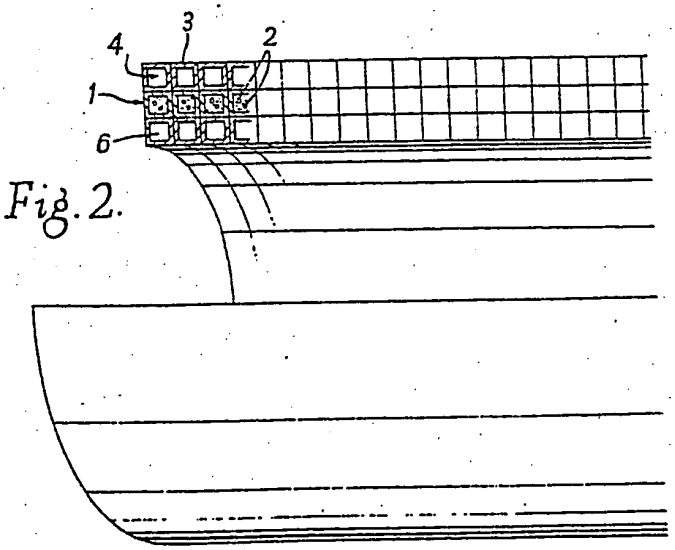

Fig.2.

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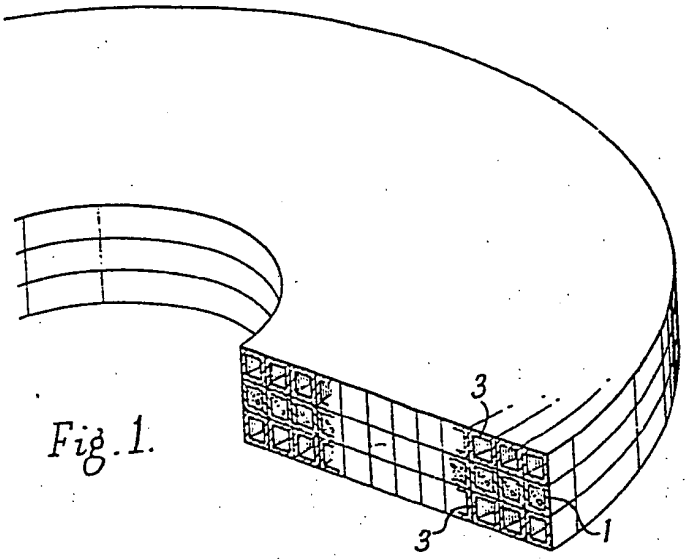
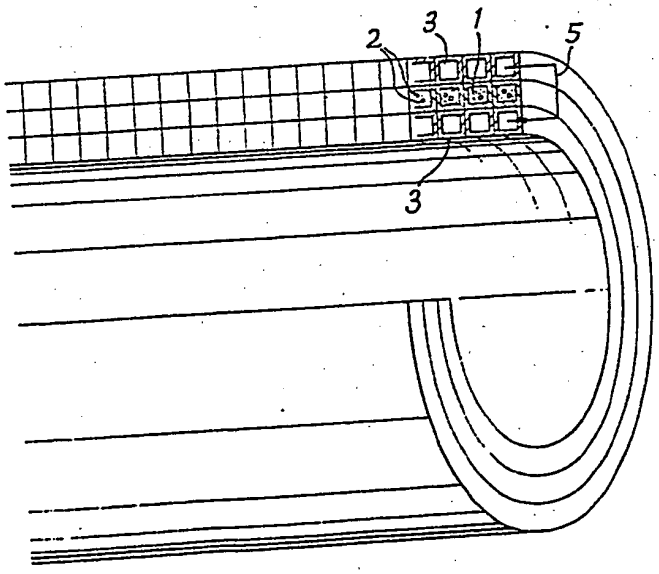


Fig. 1.



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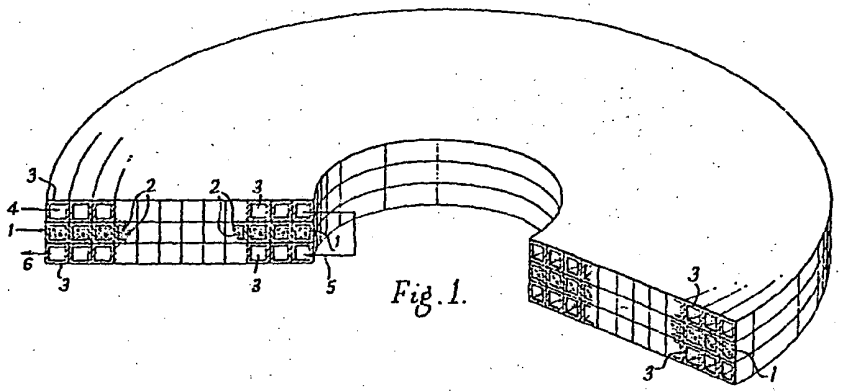

Fig. 1.

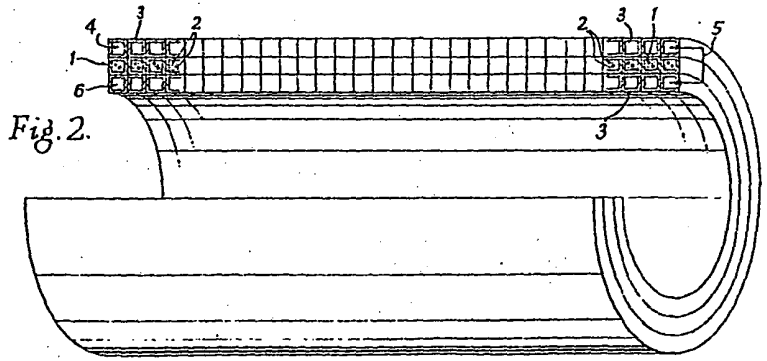

Fig. 2.

Fig. 3.

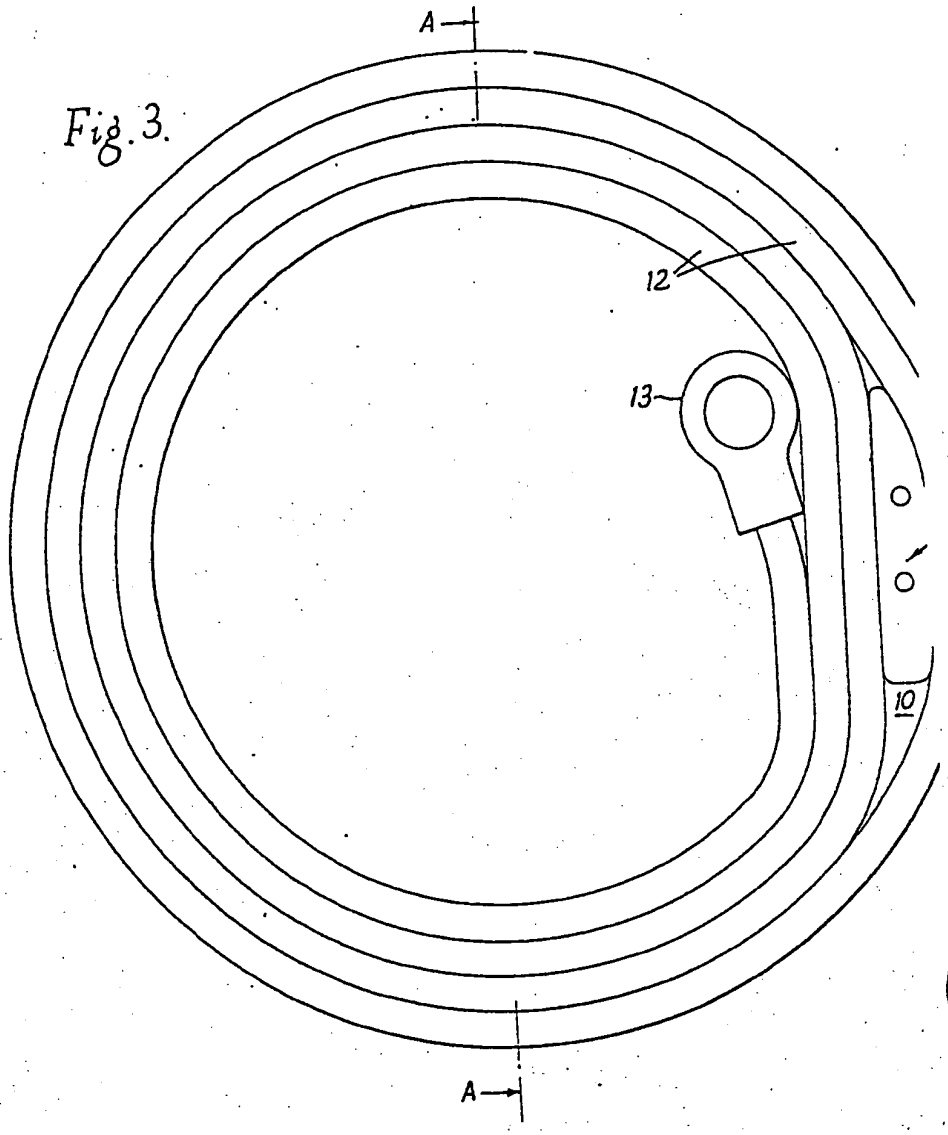

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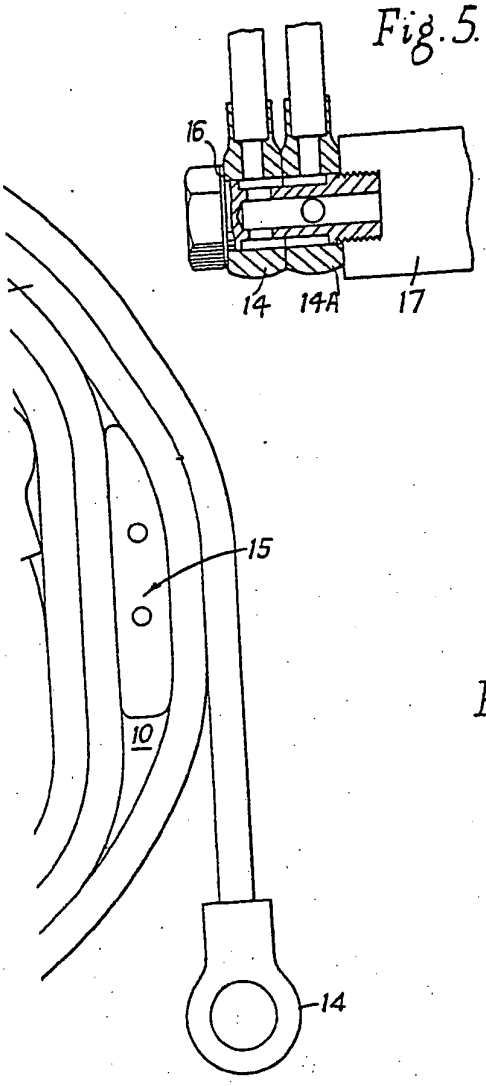
Fig.5.



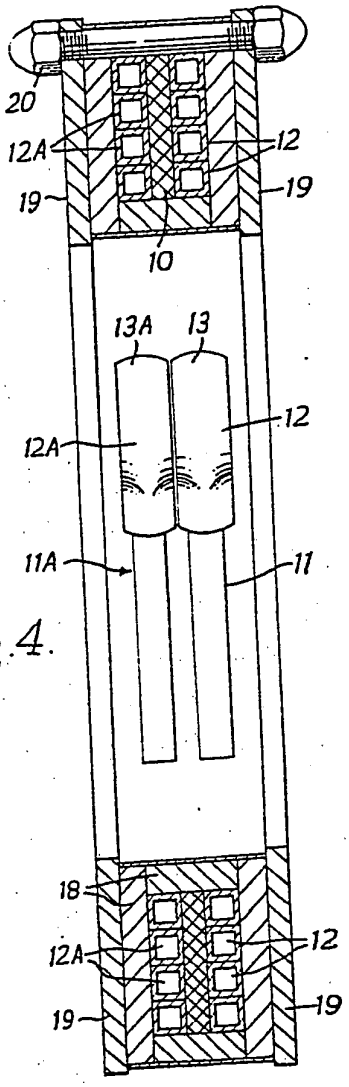


Fig.4.

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Fig.3.

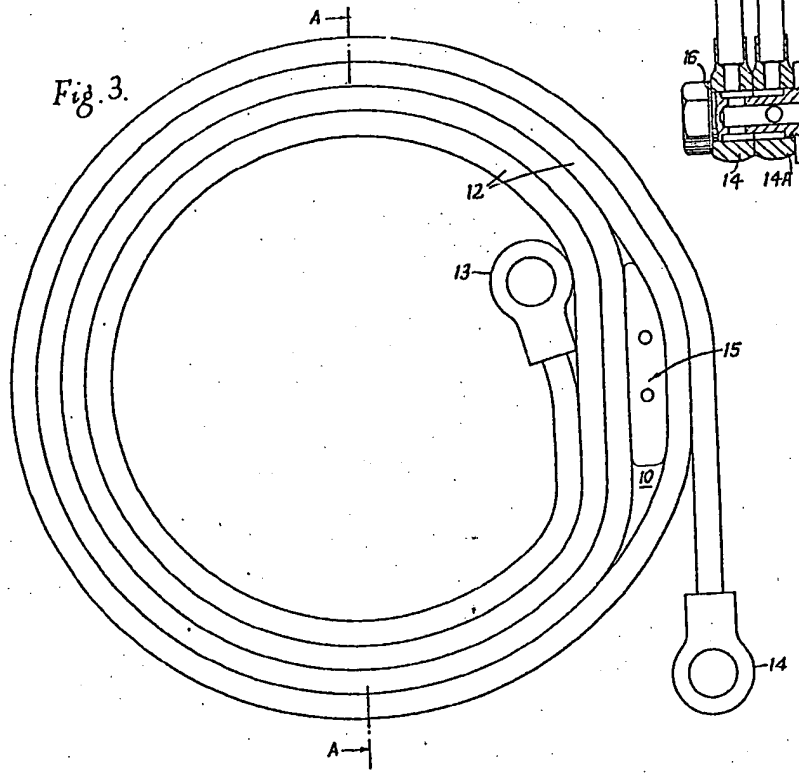

Fig.5.

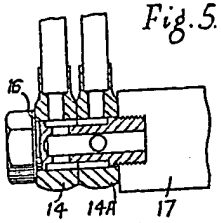

Fig.4.